FINAL PROJECT

DESIGN OF PROPORTIONAL INTEGRAL DERIVATIVE (PID) CONTROLLER FOR BUS SUSPENSION SYSTEM USING MATLAB SOFTWARE

RESEARCH PAPER

Submitted as a Partial Fulfillment of the Requirements for Getting Bachelor Degree of Engineering in Automotive Department

by

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July 2011

DECLARATION

I hereby declare that this final project report entitled

DESIGN OF PROPORTIONAL INTEGRAL DERIVATIVE (PID) CONTROLLER FOR BUS SUSPENSION SYSTEM USING MATLAB SOFTWARE

is written by me and is my own effort and that no part has been plagiarized without citations. If there is mistake in the writer's statements I will be wholly responsible.

Surakarta, July 2011
The Writer

Muhammad Iqbal

APPROVAL

The final project entitles **"Design of Proportional Integral Derivative (PID) Controller for Bus Suspension System using Matlab Software"**, has been approved by supervisor and authorized by Director of International Program as partial fulfillment of the requirements for getting the Bachelor Degree of Engineering in Automotive Department of Muhammadiyah University of Surakarta.

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The Final Project entitled **"Design of Proportional Integral Derivative Controller for Bus Suspension System using Matlab Software"**, has been defended in front of examiners team and approved as a partial fulfillment of the requirements for getting the Bachelor degree of Engineering in Automotive Department of Muhammadiyah University of Surakarta.

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ABSTRACT

Muhammad Iqbal. D 700 070 008. Design of Proportional Integral Derivative (PID) Controller for Bus Suspension System Using Matlab Software. Muhammadiyah University of Surakarta. 2011.

The research is presented as a development of an active suspension system for quarter-car model to improve the system's performance of car by applying a Proportional Integral Derivative (PID) controller. The method used to achieve the goal of this research is by using computer simulation in Matlab.

The research is started by modeling bus suspension system as a quarter model in a free body diagram to get the equations of motion. Then, this equations of motion is transformed into state space and transfer function model to get the loop control. After getting the open loop and the closed loop system, the design of PID controller is done. The controller design deals with the selection of proportional, integral, and derivative gain parameters (Kp, Ki, and Kd).

The results from simulation show that by applying PID controller to the suspension system, performance of the system has been improved. It reduced the settling time of natural response from 33.5 seconds to less than 5 seconds. The peak amplitude and the rise time have been also improved, which are from 2.25×10^{-5} m and 0.24 seconds becoming -8.8×10^{-3} m, and 0.13 seconds, respectively. Further, the steady state error is 3.35×10^{-6} m which indicates that the system has satisfied the passenger comfort.

Key words: *Active Suspension, Quarter Car Model, PID Controller*

ACKNOWLEDGEMENT

Assalamu 'alaikum Wr. Wb.

Alhamdulillahirabbil'alamin. Praise be to Allah, The Great Rabb, the Most Gentle and Beneficiant, because of His blessing and guidance, the research paper can be finished.

The Final Project entitles "Design of Proportional Integral Derivative (PID) Controller for Bus Suspension System Using Matlab Software" can be finished because of helping and supporting from other people. Here, the writer most grateful to the following people for their comments and suggestions, especially to:

1. **Ir. Agus Riyanto, MT.**, as the Dean of Engineering Faculty of Muhammadiyah University of Surakarta.
2. **Ir. Sartono Putro, MT.**, as the Head of Mechanical Engineering Department of Muhammadiyah University of Surakarta.
3. **Dr. Supriyono**, as Director of International Program of Muhammadiyah University of Surakarta.
4. **Wijianto, ST. M.Eng. Sc.**, as the first supervisor who has given many ooportunities to the writer to develop the project.
5. **Ir. Pramuko Ilmu Purbo Putro, MT.**, as the second supervisor who has given corrections and suggestions wisely.

6. **All lecturers** of Automotive Engineering Department for the guidance and share the knowledge during study in the class.
7. The late of **His Mother (Almh. Masenih)**, may you are in piece beside Him (Allah), and **His Father (Rimin)** who always prays support the writer. Hopefully, the writer will not let them disappointed.
8. His old brothers (**Mstaqiem and Mu'min)** thanks so much for your support and care.
9. All **his beloved friends** in Automotive Engineering especially **writer's classmate '07** as the first generation **(Soni, Binyamin, Gunawan, Tunggul, Amar, David, Rifqi and Aldi)**, thanks for nice friendship.
10. His **friends** and staffs in **Pesma KH Mas Mansur**, thanks for accompany him during his study.
11. Finally, the writer wish to thanks his honey, his love, and his Rose, **(Rosalina)**, thank you very much for your supports, suggestions, and dear, without whose patience, and encouragement this paper might not have been completed.

The writer realizes that this research paper is far from being perfect, so the writer sincerely welcomes any constructive comment, criticism, and suggestion.

Wassalamu 'alaikum Wr. Wb.

Surakarta, July 2011
The Writer

MOTTO

- Try to not become a man of succes, but rather, try to become a man of value.

- Wise man talks because they have something to say. Fool man talks because they have to say something.

- If you cannot be a smart person, so be a good person.

- "Verily, never will Allah change the condition of a people until they change it (their state of goodness)"

  ...(QS. Ar-Ra'du: 11)

- "Nay, seek (Allah's) help with patient perseverance and prayer: It is indeed hard, except to those who bring a lowly spirit"

  ...(QS. Al-Baqarah: 45)